WILL BIOCHAR BE THE HOLY GRAIL

FOR SOIL HEALTH IN AFRICA?

Keshav Kranthi
Chief Scientist

INTERNATIONAL COTTON ADVISORY COMMITTEE
ICAC

COTTON YIELDS ARE LOW IN AFRICA

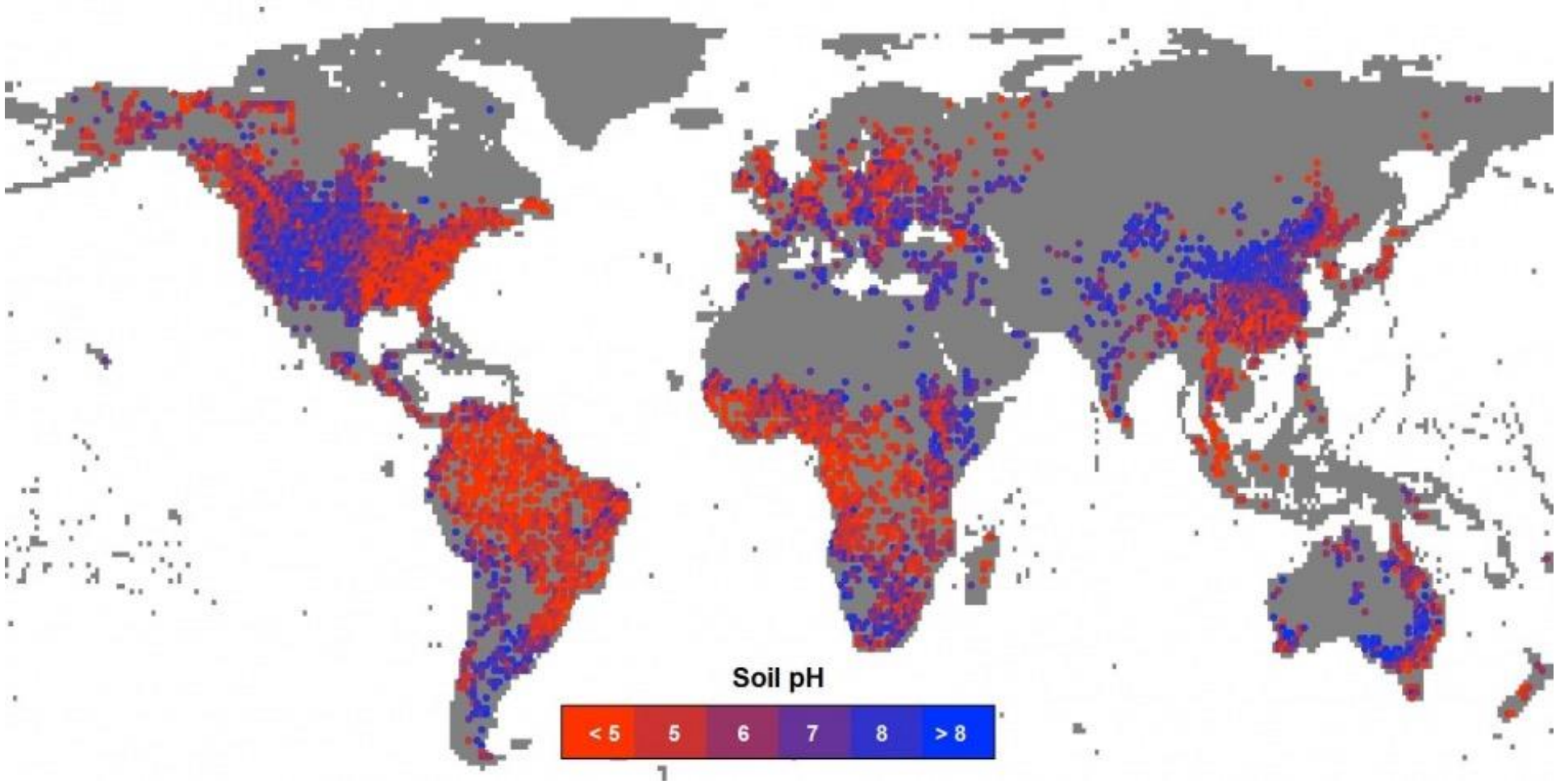
1. ACIDIC SOILS
2. HIGH BULK DENSITY
3. LOW CEC
   Cation Exchange Capacity

BIOCHAR FROM COTTON STALKS HAS THE PROPERTIES TO REMEDIATE AFRICAN SOILS

	AFRICAN SOILS	BIOCHAR
pH	Acidic	Alkaline
CEC	Low	High
Bulk Density	High	Very Low

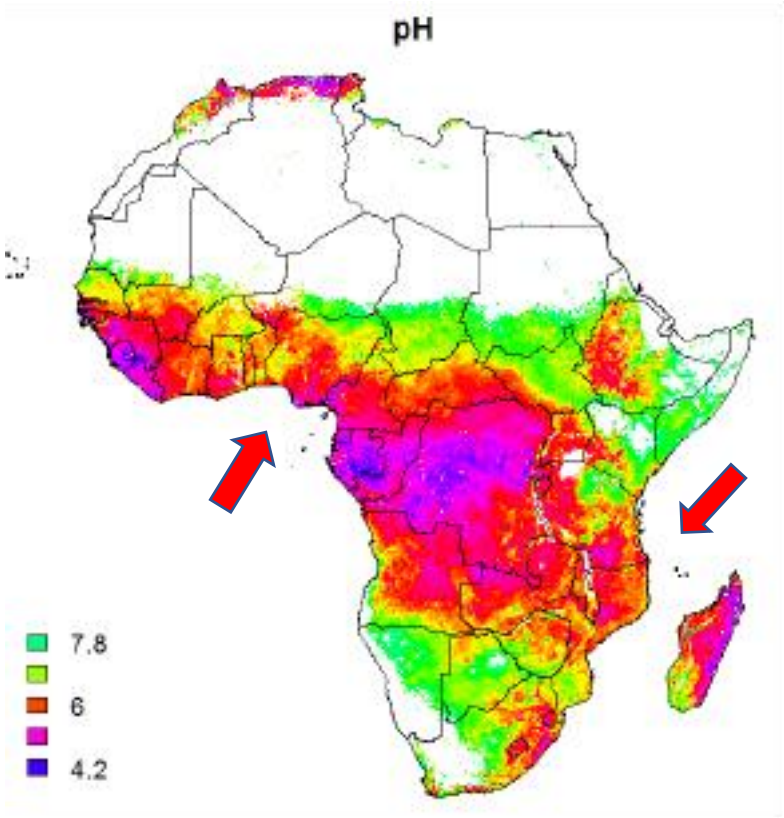
THE PROBLEM WITH SOILS IN AFRICA

MOST AFRICAN SOILS ARE ACIDIC



Source: Slessarev, E., Lin, Y., Bingham, N. *et al. Nature* **540**, 567–569 (2016).
https://scx2.b-cdn.net/gfx/news/hires/2016/5849a7bef1d77.jpeg

Most soils of cotton growing countries in West Africa and South-East Africa are **acidic**



https://www.isric.org/projects/africa-soil-profiles-database-afsp/newgeneration

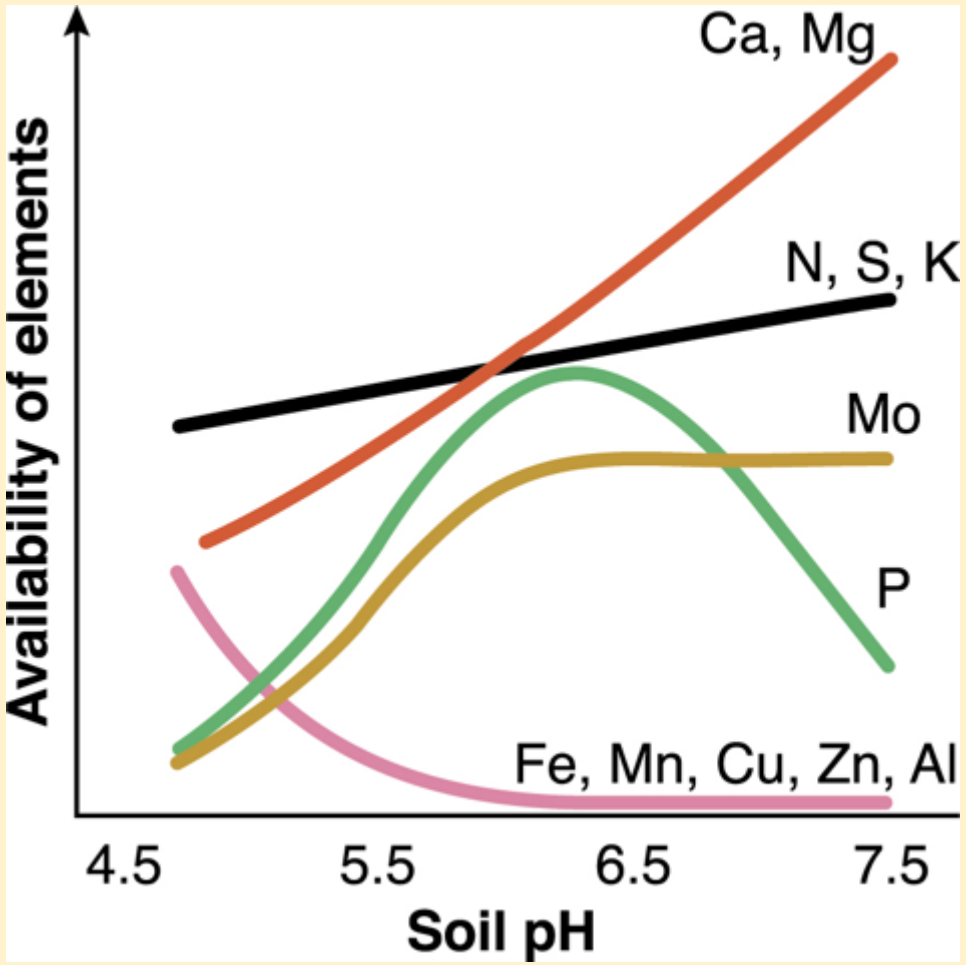
Yields in acidic soils will be low

- Without lime application &
- Without application of high levels of synthetic fertilizers

Unfortunately, synthetic fertilizers in Africa are the most expensive.

Example:
Urea 50 Kg = US$ 3.5 in India
Urea 50 Kg = US$ 50+ in Africa

YIELDS ARE LOW IN ACIDIC SOILS



ACIDIC SOILS CAUSE NUTRIENT DEFICIENCY

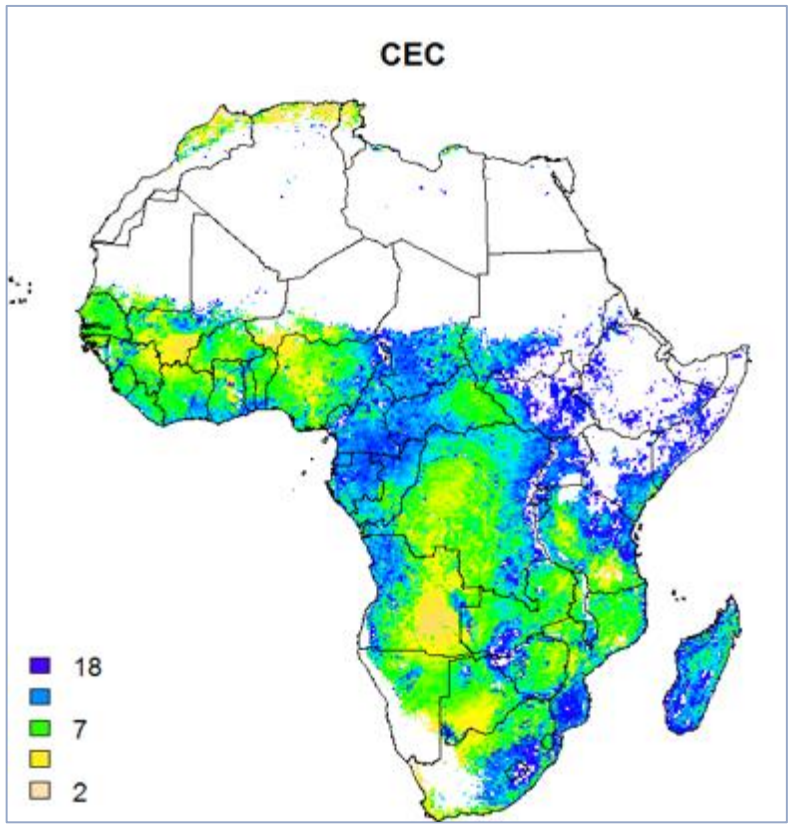
N	P	K
NITROGEN	PHOSPHORUS	POTASSIUM
S	Ca	Mg
SULPHUR	PHOSPHORUS	POTASSIUM

Mn	Al
MANGANESE	ALUMINUM

ACIDIC SOILS CAUSE MINERAL TOXICITY

CATION EXCHANGE CAPACITY (CEC)

Most soils of cotton growing countries in West Africa and South-East Africa have low CEC



LOW CEC LEADS TO NUTRIENT DEFICIENCY

K
POTASSIUM

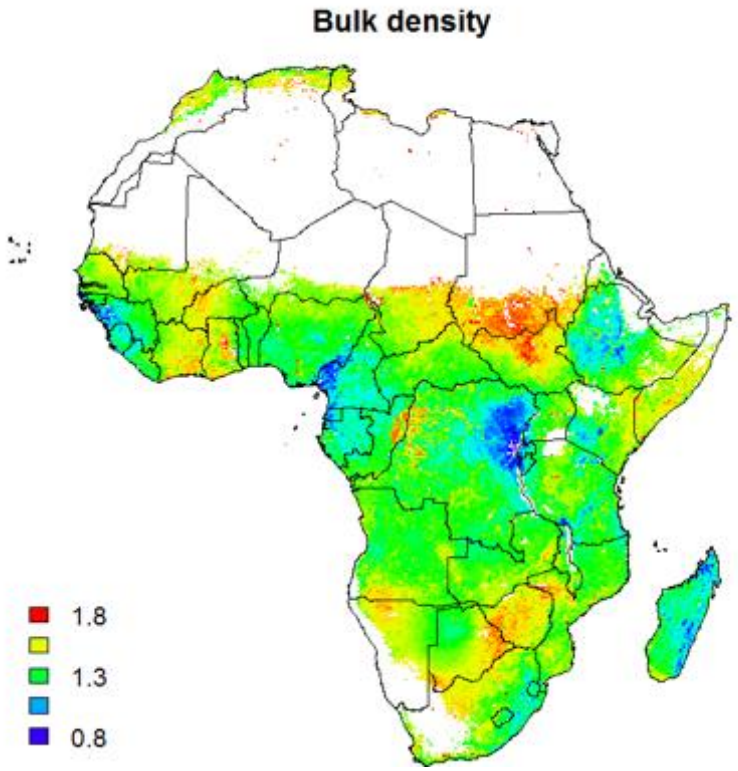
Ca
PHOSPHORUS

Mg
POTASSIUM

https://www.isric.org/projects/africa-soil-profiles-database-afsp/newgeneration

SOIL BULK DENSITY

Most soils of cotton growing countries in West Africa and South-East Africa have high Bulk Density



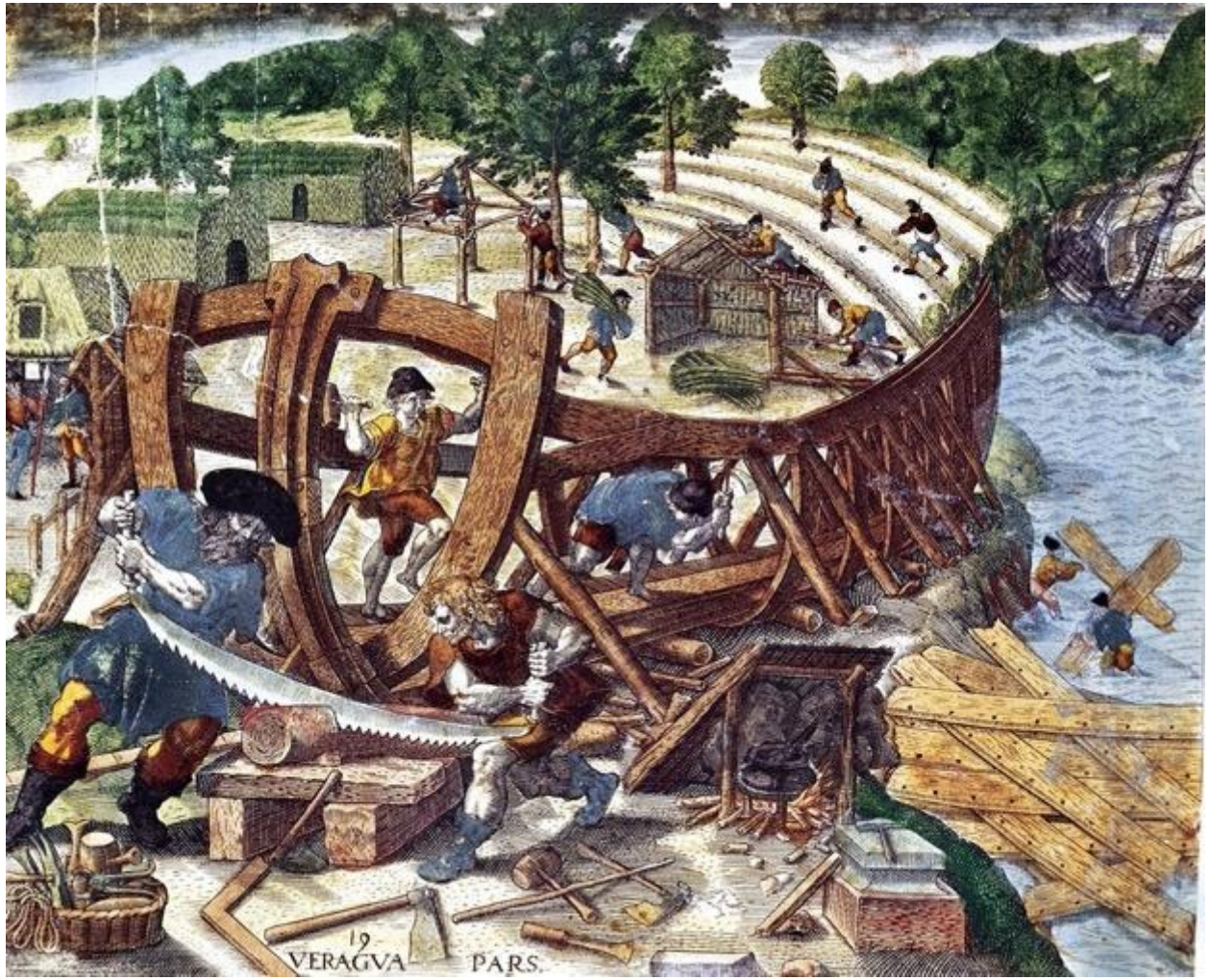
- SOIL COMPACTION
- POOR ROOT GROWTH
- WEAK MICROBIAL ACTIVITY
- LOW POROSITY
- REDUCED WATER INFILTRATION
- INCREASED SOIL EROSION
- POOR SOIL AERATION
- POOR WATER MOVEMENT
- WATER LOGGING

https://www.isric.org/projects/africa-soil-profiles-database-afsp/newgeneration

THE SOLUTION

THE STORY OF TERRA PRETA

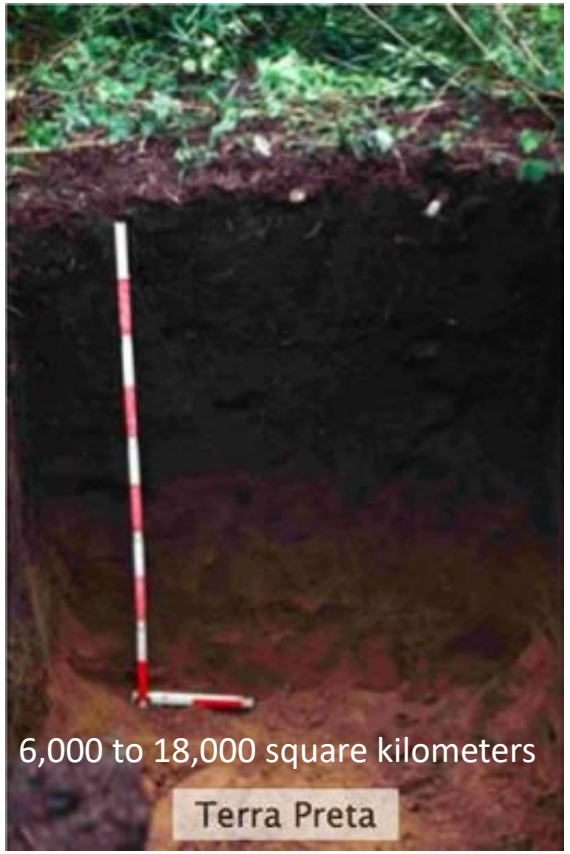
BLACK FERTILE SOILS IN BRAZILIAN AMAZON WERE FIRST DESCRIBED BY FRANCISCO ORELLANA



BIOCHAR IN TERRA PRETA

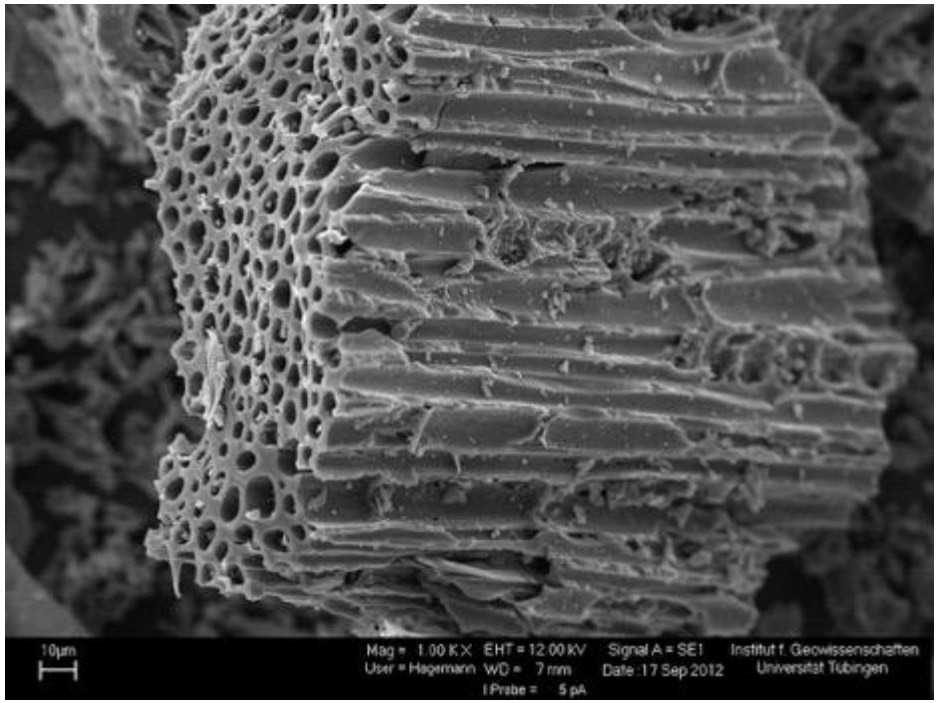
Created 2500 years in Amazon, Terra Preta soils continue to support high yielding crops and be fertile without addition of synthetic fertilizers

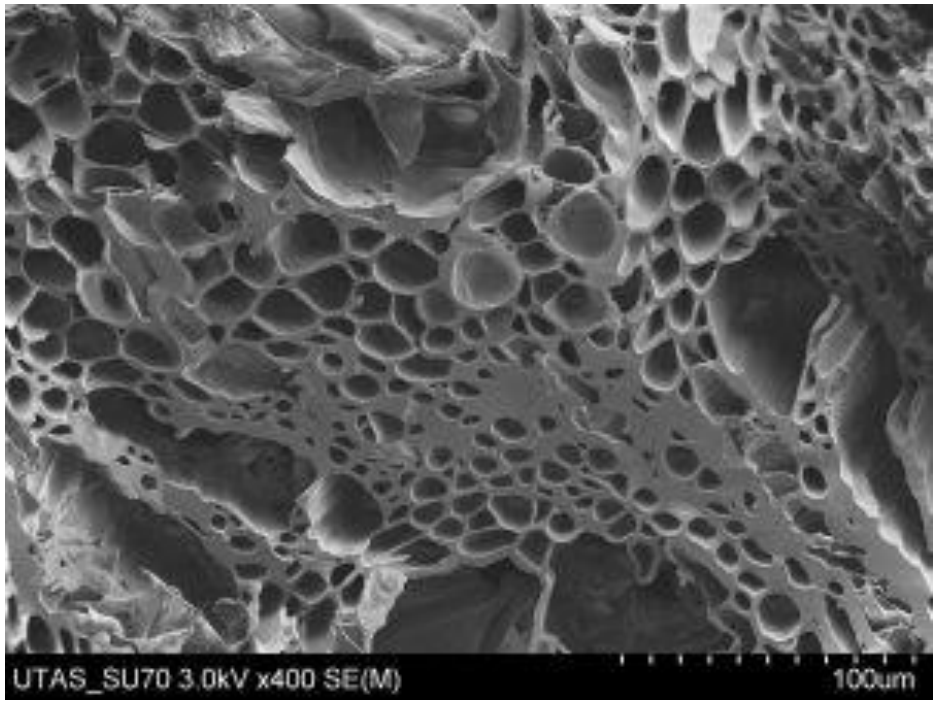
- High phosphorus content: 200-400 mg P/kg, and
- Higher cation exchange capacity,
- Higher pH and base saturation than surrounding soils.



BIOCHAR

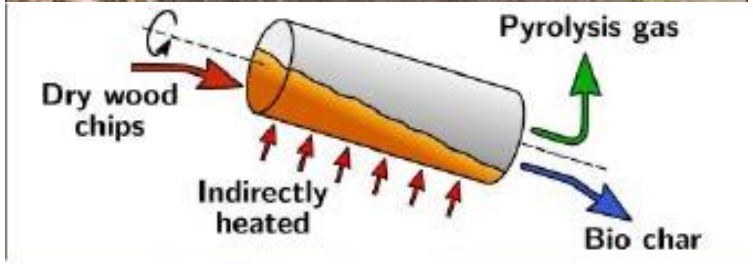
- Biochar is charcoal made from biological material and used to improve soil health.
- Biochar can be produced from farm residue such as stalks of maize, cotton, sunflower etc.,
- It is rich in carbon therefore it supports microbial growth in soils.
- It highly porous, therefore it improves soil structure and helps to retain water and nutrients.





There are several designs of commercial kilns and retorts

https://biochar.international/guides/biochar-reactor-to-meet-needs/



KON-TIKI

The Kon-tiki has emerged as the method of choice

- Ease of operation
- Low cost

https://bestbiocharkiln.com/product/best-biochar-kiln/

Shmidt and Taylor: 2014 Ithaca Journal

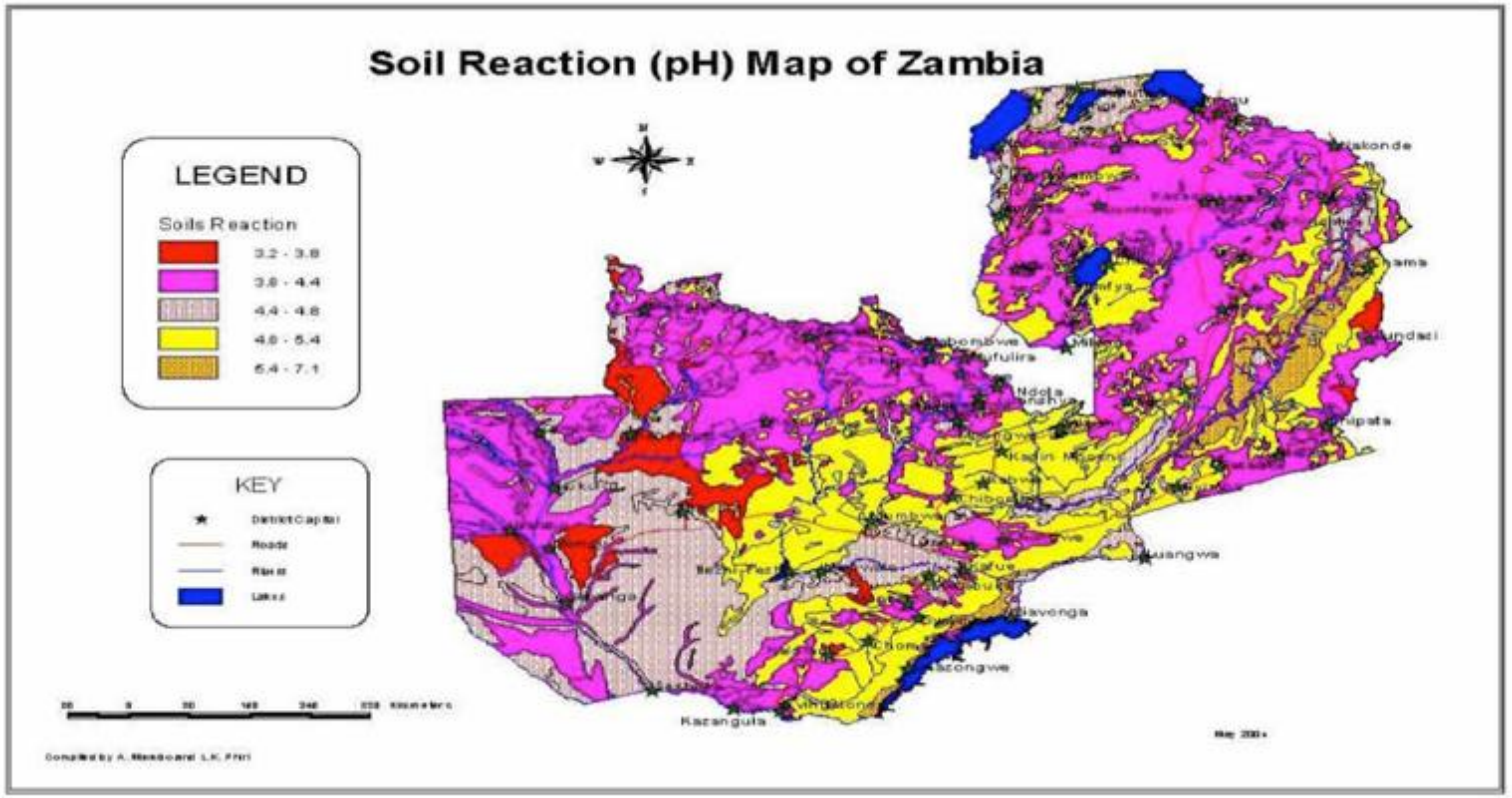
BIOCHAR

- Improves soil structure
- Increases water retention
- Decreases soil acidity and
- Improves microbial activity in soil

BIOCHAR FROM COTTON STALKS 3-4 TONNES/DAY

Four Tons/ha of Biochar + Biomass will Increase the SOC by 0.1%

ZAMBIAN SOILS ARE ACIDIC



BIOCHAR FROM COTTON STALKS

- ALKALINE (pH 9.0)
- EXCELLENT CEC (46-51%)
- CARBON CONTENT (59-68%)

Load Kg/Kiln	pH	CEC	Carbon %
11	9.2	46.3	59.2
20	8.9	51.3	66.8
27	9.0	49.5	67.9

Venkatesh et. al. 2013 Indian J. Dryland Agric. Res. & Dev. 2013 28(1) : 48-57

CONVERT COTTON STALKS TO BIOCHAR

- Every year, Africa produces 13 Million tonnes cotton stalks.
- **Burning them releases 22 million tons of CO_2 instantaneously**
- Slashing cotton stalks and incorporation into soil releases 21 million tonnes of CO_2

- Converting 13 million tons of cotton stalks into biochar will fix about 20 million tonnes of CO_2 (as 5.5 tons of carbon) into the soil to make cotton farming climate positive to achieve far beyond net-zero emissions.
- **Yields will increase significantly and sustainably.**

Creating Synthetic Terra Preta

- Biochar
- Legume Nitrogen fixation
- Green leaves
- Dry Hay
- Cattle manure
- Molasses
- Jeeavmrit (Local biofertilizer)

INTERNATIONAL COTTON ADVISORY COMMITTEE

Thank You